



FIG. 3

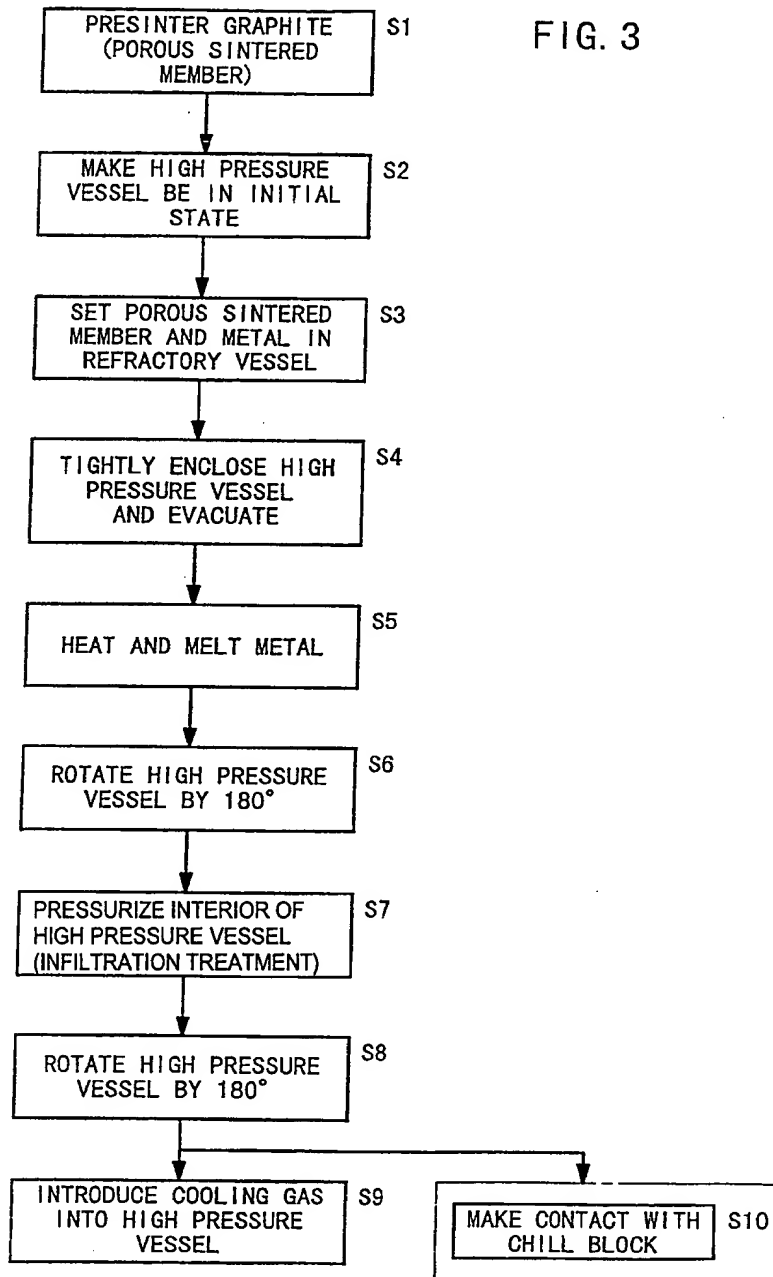
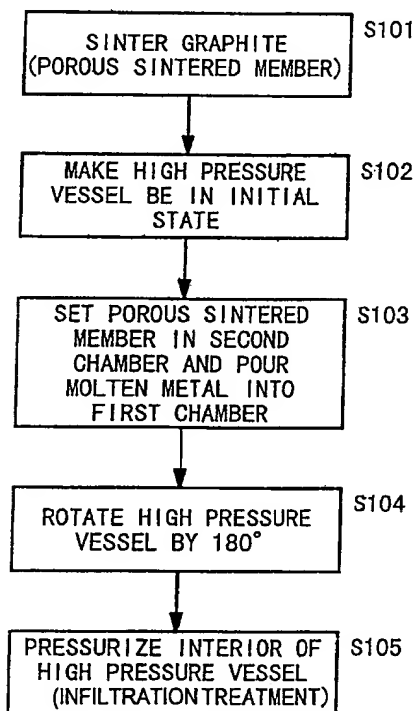
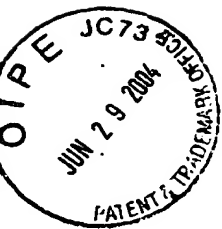




FIG. 4





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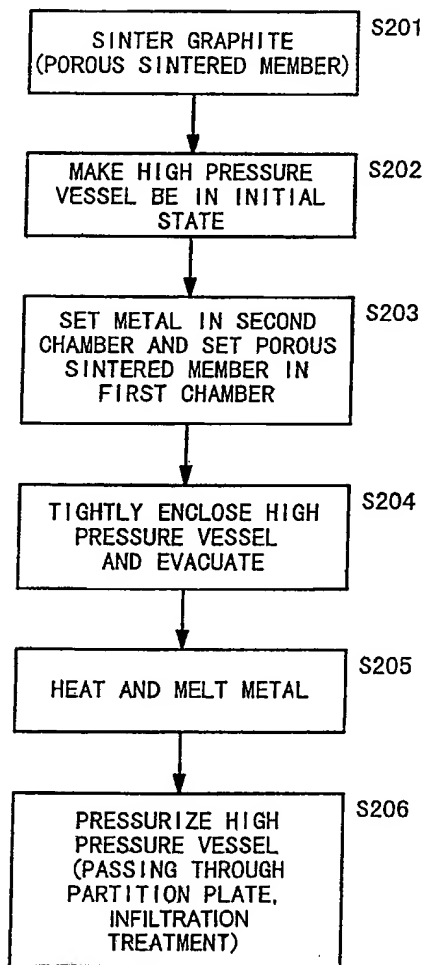
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FIG. 5



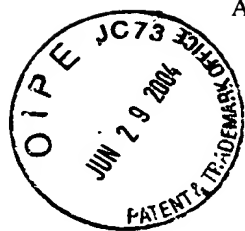
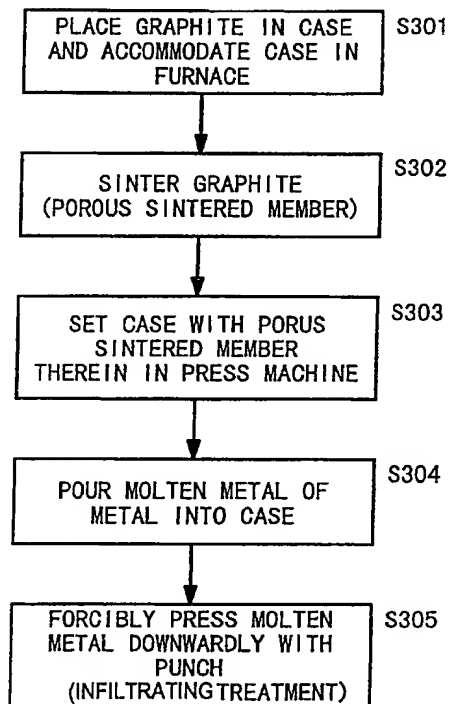


FIG. 8





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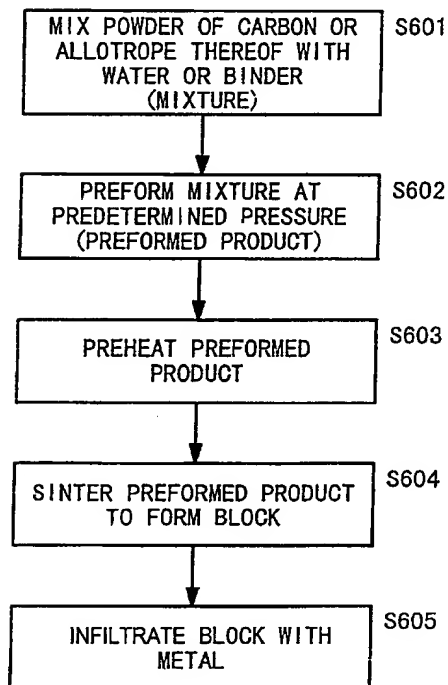
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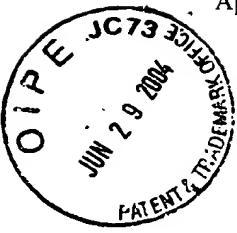
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FIG. 16

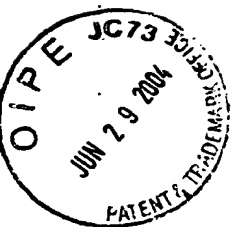




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FIG. 17

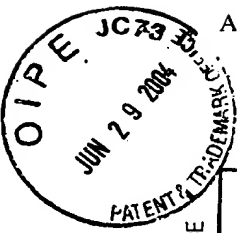
SAMPLE	SIZE (mm)	TYPE OF POWDER	PARTICLE SIZE OF POWDER (μ m)	FILLING METHOD	METAL ADDED ELEMENT			WATER RESISTANCE			
					AMOUNT OF ADDITION (wt%)	INFIL- TRATION METHOD	INFIL- TRATION PRESSURE (MPa)	COEFFICIENT OF THERMAL CONDUCTIVITY (W/mK)	COEFFICIENT OF THERMAL EXPANSION ($\times 10^{-6}/K$)	EFFECT	GENERATION OF CARBIDE
PW-1	30 x120 x190	type -P	AVERAGE 120	NO PRESSUR- IZATION	Cu Nb	0.001	PRESS	60.0	321	14.0	Δ
PW-2	30 x120 x191	type -S	AVERAGE 50	NO PRESSUR- IZATION	Cu Nb	0.001	PRESS	60.0	325	13.5	Δ
PW-3	30 x120 x192	type -R	212- 1180	NO PRESSUR- IZATION	Cu Nb	0.001	PRESS	60.0	305	13.6	Δ
PW-4	30 x120 x193	type -P	AVERAGE 120	NO PRESSUR- IZATION	Cu Nb	0.001	PRESS	60.0	321	14.0	Δ
PW-5	30 x120 x194	type -P	AVERAGE 120	PRESSUR- IZATION 7MPa	Cu Nb	0.001	PRESS	60.0	311	11.5	Δ
PW-6	30 x120 x195	type -P	AVERAGE 120	PRESSUR- IZATION 25MPa	Cu Nb	1.001	PRESS	60.0	301	9.5	Δ



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FIG. 19

SAMPLE	SIZE (mm)	METAL	ELEMENT	AMOUNT OF ADDITION (wt%)	INFIL- TRATING METHOD	COEFFICIENT OF THERMAL CONDUCTIVITY (W/mK)		COEFFICIENT OF THERMAL EXPANSION ($\times 10^{-6}/^{\circ}\text{C}$)		BENDING STRENGTH (MPa)		WATER RESISTANCE	EFFECT
						SUR- FACE	THICK- NESS	SUR- FACE	THICK- NESS	SUR- FACE	THICK- NESS		
p1-1	20x60x60	Al	NONE	NONE	PRESS	171	171	5.3	5.5	33.3	53.9	Δ	NONE
p1-2	20x60x60	Cu	NONE	NONE	PRESS	162	170	5.1	5.1	27.4	41.2	⊙	NONE
p2-1	20x60x60	Cu	Bi	2	PRESS	168	178	5.0	5.1	28.4	45.1	⊙	WETT- ABILITY
p2-2	20x60x60	Cu	Sb	0.5		178	186	5.0	5.1	27.4	41.2		
p2-3	20x60x60	Cu	Te	0.5		180	189	5.0	5.1	26.5	39.2		
p2-4	20x60x60	Cu	Te	2		172	178	4.9	5.0	25.5	38.2		
p2-5	20x60x60	Cu	Te, Bi	0.5, 0.5		169	176	5.0	5.0	26.5	39.2		
p2-6	20x60x60	Cu	Te, Pb	0.5, 2.0		172	185	5.0	5.0	27.4	41.2		
p3-1	20x60x60	Cu	Be	1	PRESS	184	204	5.0	5.0	34.3	57.8	Δ	GENERATION OF CARBIDE
p3-2	20x60x60	Cu	Cr	0.5		187	192	5.0	5.0	37.2	58.8		
p3-3	20x60x60	Cu	Mn	0.5		175	181	5.0	5.0	34.3	56.8		
p3-4	20x60x60	Cu	Nb	0.05		187	190	5.0	5.0	34.3	56.8		
p3-5	20x60x60	Cu	Zr	0.5		172	174	5.0	5.0	24.5	40.2		
p4-1	20x60x60	Cu	Te, Ni	0.5, 0.5	PRESS	165	177	5.0	5.0	27.4	45.1	○	COMBINED ADDITION
p5-1	20x60x60	Cu	NONE	NONE	GAS	170	188	5.0	5.0	27.4	41.2	⊙	NONE
p6-1	10x85x180	Cu	Te	2	GAS	185	196	5.0	5.1	26.5	39.2	⊙	WETT- ABILITY
p6-2	20x60x60	Cu	Te	2		192	204	5.0	5.0	28.4	42.1		



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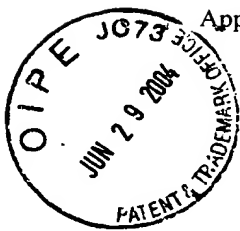
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FIG. 21

SAMPLE	SIZE (mm)	METAL	INFILTRATING METHOD		INFILTRATION PRESSURE COEFFICIENT OF THERMAL EXPANSION ($\mu\text{W}/\text{mK}$)		COEFFICIENT OF THERMAL EXPANSION ($\times 10^{-6}/\text{K}$)		BENDING STRENGTH (MPa)		COMPRESSION STRENGTH (MPa)		WATER RESISTANCE		EFFECT
			AMOUNT OF ADDITION (wt%)		(MPa)										
n1-1	20×60×60	Al	NONE	PRESS	26.7	156	311	5.5	6.0	31.4	51.9	46.1	51.0	△	NONE
n1-4	20×120×190	Al	NONE	PRESS	60.0	185	350	5.5	6.5					△	NONE
n1-2	20×60×60	Cu	NONE	PRESS	26.7	150	310	3.8	4.5	26.5	39.2			◎	NONE
n1-3	20×120×190	Cu	NONE	PRESS	26.7	147	268	3.9	4.5	26.5	39.2			◎	NONE
n2-1	20×60×60	Cu	0.500	PRESS	26.7	190	351	3.8	4.5	26.5	39.2			◎	WETTABILITY
n3-1	20×60×60	Cu	1.000	PRESS	26.7	183	341	3.8	4.5	38.2	62.7			△	GENERATION OF CARBIDE
n3-2	20×120×190	Cu	1.000	PRESS	156.1	189	342	4.0	4.6	37.2	61.7			△	
n3-3	20×60×60	Cu	0.500	PRESS	26.7	180	320	3.8	4.5	36.3	59.8			△	
n3-4	20×60×60	Cu	0.500	PRESS	26.7	176	330	3.8	4.5	34.3	55.9			△	
n3-5	20×60×60	Cu	0.050	PRESS	156.1	198	336	3.8	4.5	35.3	57.8			△	
n3-6	20×120×190	Cu	0.050	PRESS	26.7	187	309	3.8	4.5	35.3	57.8			△	
n3-7	20×60×60	Cu	0.500	PRESS	26.7	188	312	3.8	4.5	34.3	56.8			△	
n3-8	20×120×190	Cu	0.001	PRESS	43.3	182	352	4.5	3.0					△	
n3-9	20×120×190	Cu	0.001	PRESS	60.0	182	363	4.0	3.0					△	
n3-10	20×120×190	Cu	1.100	PRESS	60.0	196	359	4.0	2.5					△	
n3-11	20×120×190	Cu	1.900	PRESS	60.0	186	366	4.5	3.5					△	COMBINED ADDITION OF GENERATION OF CARBIDE EXPANSION OF SOLID-LIQUID RANGE NONE GENERATION OF CARBIDE EXPANSION OF SOLID-LIQUID RANGE
n3-12	20×120×190	Cu	9.4, 6.7	PRESS	60.0	190	343							△	
n3-13	20×120×190	Cu	1.0, 0.23, 0.04	PRESS	60.0	190	353							△	
n3-14	20×120×190	Cu	4.180	PRESS	60.0	181	352							△	
n3-15	20×120×190	Cu	2.870	PRESS	60.0	195	387							△	
n3-16	20×120×190	Cu	4.490	PRESS	60.0	207	367							△	
n3-17	20×120×190	Cu	11.300	PRESS	26.7	157	333							△	
n3-18	20×120×190	Cu	10.900	PRESS	60.0	159	316							△	
n3-19	20×120×190	Cu	5.170	PRESS	153.0	165	343							△	
n3-20	20×120×190	Cu	5.300	PRESS	43.3	163	325							△	
n5-1	20×60×60	Cu	NONE	GAS	26.7	170	320	3.8	4.5	26.5	39.2			◎	NONE
n7-1	20×120×190	Al	2.000	PRESS	60.0	177	332	5.0	6.5					△	GENERATION OF CARBIDE
n7-2	20×120×190	Al	5.000	PRESS	60.0	169	329	5.0	6.5					◎	EXPANSION OF SOLID-LIQUID RANGE
n7-3	20×120×190	Al	12.000	PRESS	60.0	181	327	5.0	6.5					◎	



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FIG. 23

SAMPLE	SIZE (mm)	METAL	ELEMENT	AMOUNT OF ADDITION (wt%)	INFIL- TRATING METHOD	COEFFICIENT OF THERMAL CONDUCTIVITY (W/mK)		COEFFICIENT OF THERMAL EXPANSION ($\times 10^{-6}/^{\circ}\text{C}$)		BENDING STRENGTH (MPa)		WATER RESISTANCE	EFFECT
						SUR- FACE	THICK- NESS	SUR- FACE	THICK- NESS	SUR- FACE	THICK- NESS		
p1-2	20x60x60	Cu	NONE	NONE	PRESS	162	170	5.1	5.1	27.4	41.2	☉	NONE
p5-1	20x60x60				GAS	170	188	5.0	5.0	27.4	41.2		
p2-4	20x60x60	Cu	Te	2	PRESS	172	178	4.9	5.0	25.5	38.2	☉	WETT- ABILITY
p6-2	20x60x60	Cu	Te	2	GAS	192	204	5.0	5.0	28.4	42.1		
m1-2	20x60x60				PRESS	145	181	4.5	5.1	28.4	42.1	☉	NONE
m5-1	20x60x60	Cu	NONE	NONE	GAS	166	198	4.5	5.1	25.5	38.2		
n1-2	20x60x60	Cu	NONE	NONE	PRESS	150	310	3.8	4.5	26.5	39.2	☉	NONE
n5-1	20x60x60	Cu	NONE	NONE	GAS	170	320	3.8	4.5	26.5	39.2	☉	NONE

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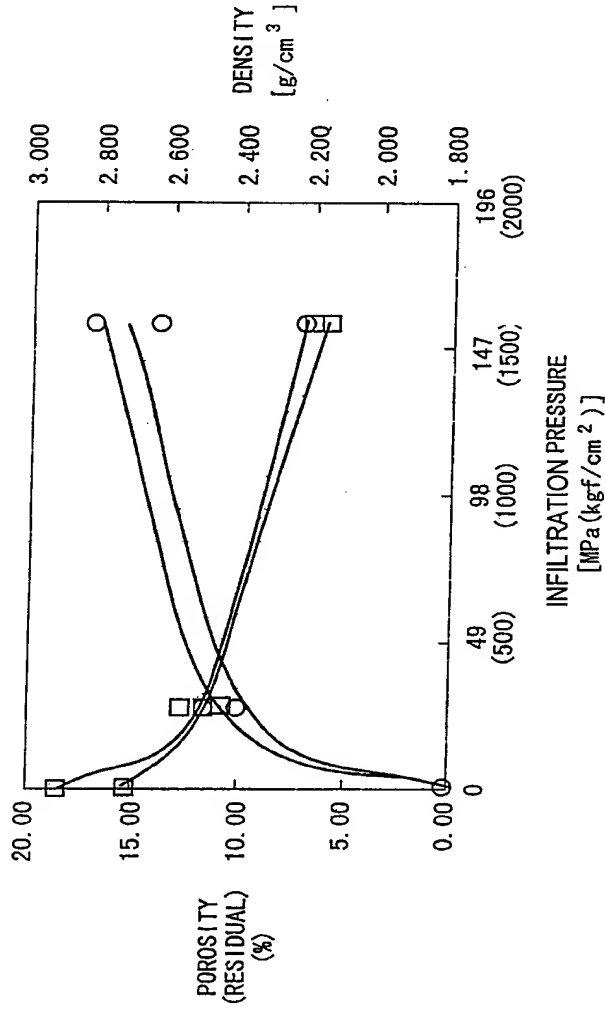
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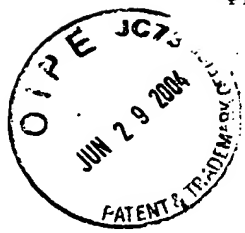
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FIG. 24





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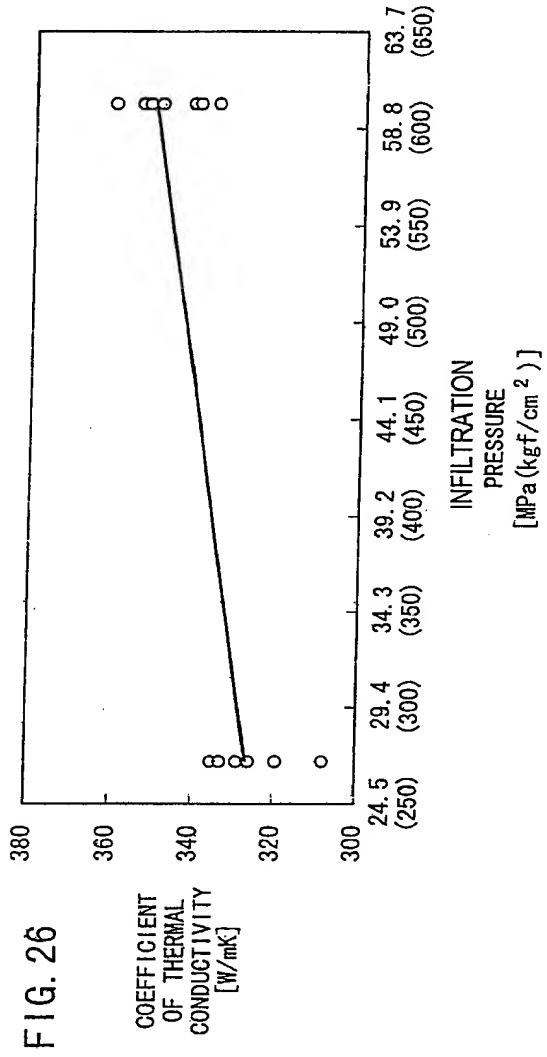
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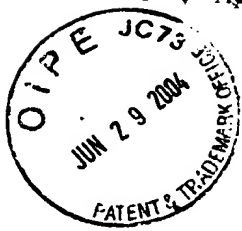
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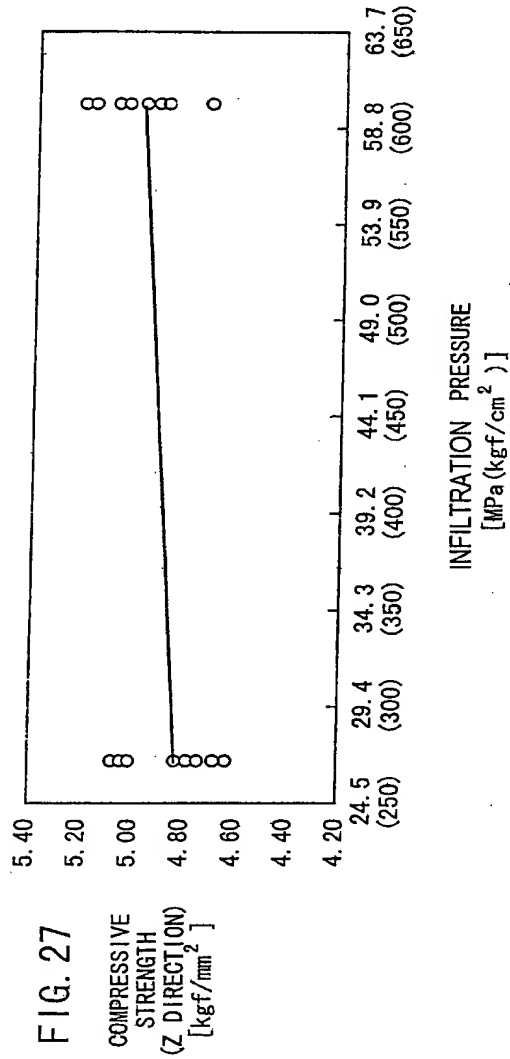
Applicant(s): Shuhei ISHIKAWA, Tsutomu MITSUI, Ken SUZUKI, Nobuaki NAKAYAMA, Hiroyuki TAKEUCHI and Seiji YASUI

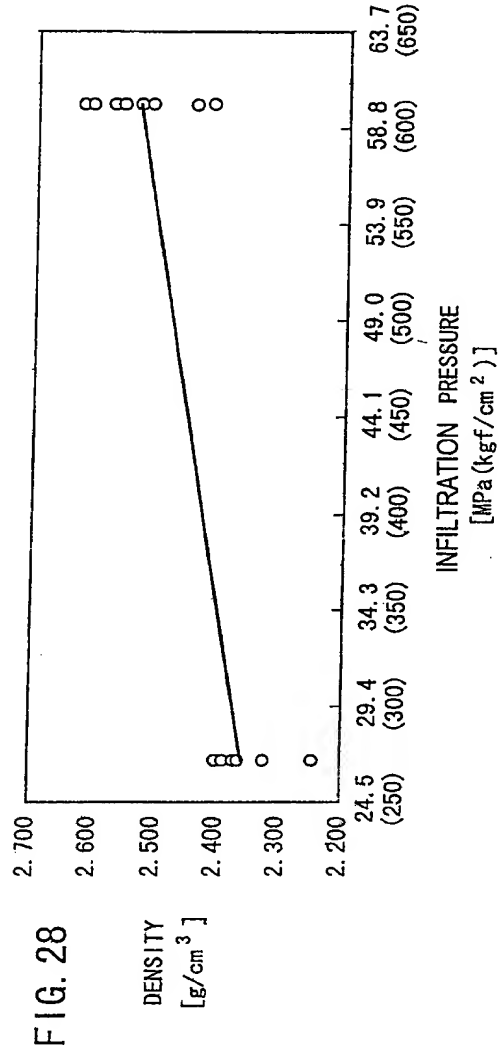
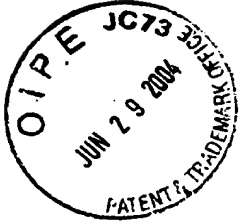
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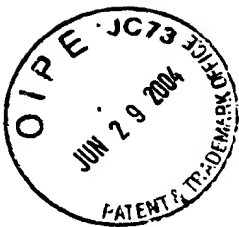
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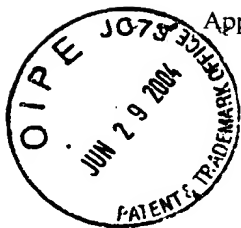


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FIG. 30

No.	POROSITY [%]	PORE DIAMETER [μm]	Ni PLATING	Si INFIL- TRATION	INFILTRATION TEMPERATURE [$^{\circ}\text{C}$]	PRESSURIZATION [MPa (kgf/cm 2)]	PRESSURIZATION TIME [sec]	COOLING SPEED [$^{\circ}\text{C}/\text{min}$]	REACTION OF Si/Cu	INFIL- TRATION
SAMPLE1	35	70	ABSENT	ABSENT	1130	0.78(8)	60	260	Δ	Δ
SAMPLE2	44	22	ABSENT	ABSENT	1130	7.84(80)	20	900	\bigcirc	\bigcirc
SAMPLE3	59	42	ABSENT	PRESENT	1130	11.8(120)	10	480	\bigcirc	\bigcirc
SAMPLE4	15	5	PRESENT	ABSENT	1130	23.5(240)	10	900	\bigcirc	\bigcirc
SAMPLE5	59	42	ABSENT	PRESENT	1180	0.78(8)	60	900	Δ	Δ
SAMPLE6	15	5	ABSENT	ABSENT	1180	3.92(40)	20	480	\bigcirc	Δ
SAMPLE7	59	42	ABSENT	PRESENT	1180	11.8(120)	10	900	\bigcirc	\bigcirc
SAMPLE8	44	22	ABSENT	ABSENT	1180	23.5(240)	10	620	\bigcirc	\bigcirc
SAMPLE9	44	22	ABSENT	PRESENT	1230	0.78(8)	20	480	\bigcirc	Δ
SAMPLE10	59	42	PRESENT	ABSENT	1230	3.92(40)	35	790	\bigcirc	\bigcirc
SAMPLE11	35	70	ABSENT	ABSENT	1230	7.84(80)	100	620	\bigcirc	\bigcirc
SAMPLE12	44	22	ABSENT	PRESENT	1230	23.5(240)	5	620	\bigcirc	\bigcirc
SAMPLE13	59	42	ABSENT	ABSENT	1280	3.92(40)	50	790	\bigcirc	\bigcirc
SAMPLE14	35	70	ABSENT	ABSENT	1280	7.84(80)	35	480	Δ	\bigcirc
SAMPLE15	44	22	PRESENT	ABSENT	1280	7.84(80)	5	620	\bigcirc	\bigcirc
SAMPLE16	59	42	ABSENT	PRESENT	1280	11.8(120)	10	790	\bigcirc	\bigcirc
SAMPLE17	20	21	ABSENT	ABSENT	1150	156.1	3	900	\bigcirc	\bigcirc
SAMPLE18	20	19	ABSENT	ABSENT	1150	156.1	5	900	\bigcirc	\bigcirc
SAMPLE19	20	23	ABSENT	ABSENT	1140	69.3	5	900	\bigcirc	\bigcirc
SAMPLE20	20	22	ABSENT	ABSENT	1145	26.7	7	900	\bigcirc	\bigcirc

NOTES REACTION of Si/Cu: \bigcirc NO REACTION \bigcirc SLIGHT REACTION Δ STRONG REACTION
 INFILTRATION OF Cu: \bigcirc GOOD INFILTRATION \bigcirc SLIGHTLY INSUFFICIENT INFILTRATION
 Δ INSUFFICIENT INFILTRATION



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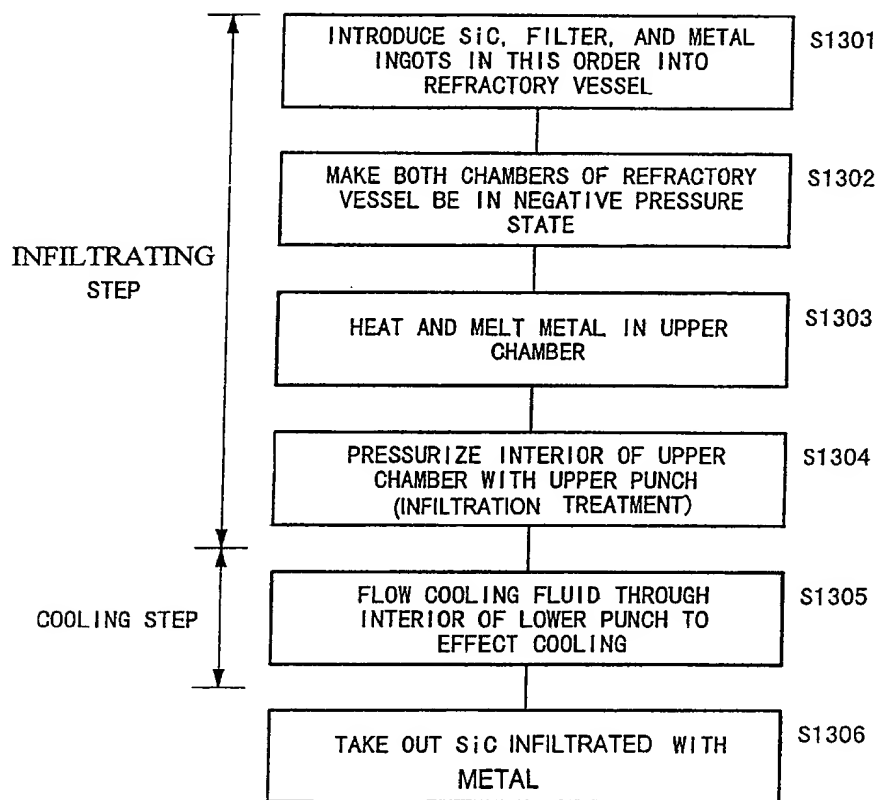
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FIG. 34



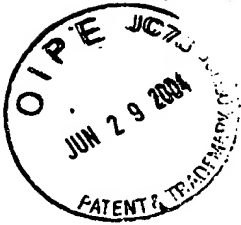
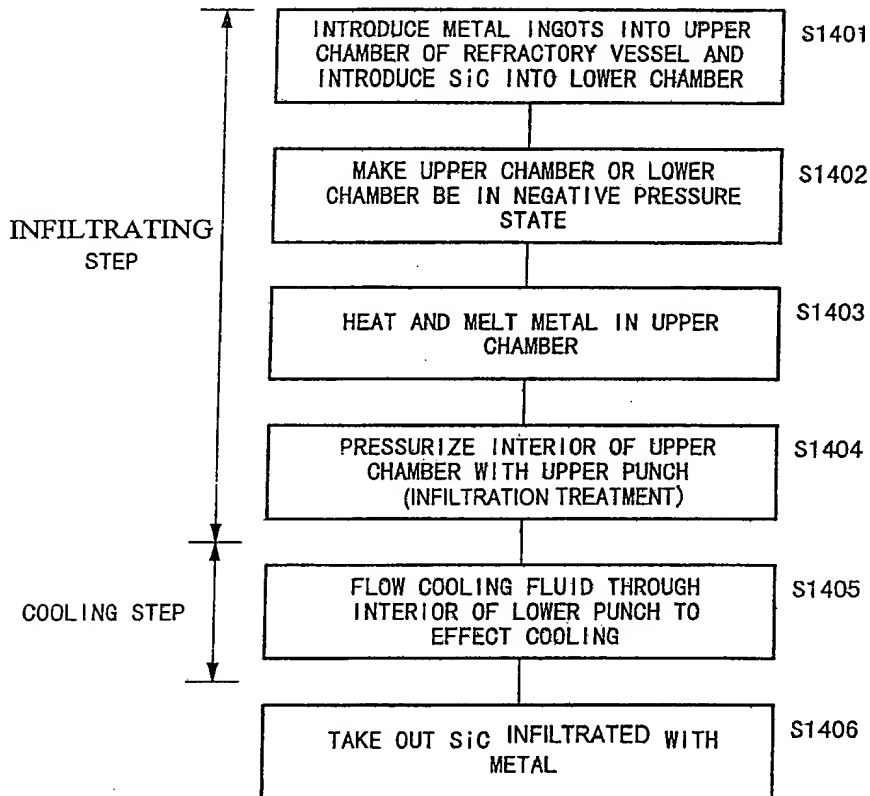


FIG. 38



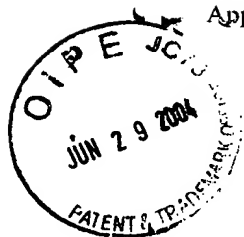


FIG. 40

